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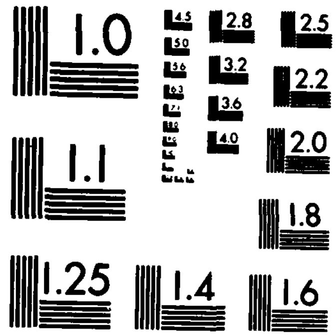

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A DECISION-ORIENTED INVESTIGATION OF AIR FORCE CIVIL ENGINEERING'S OPERATIONS BRANCH AND THE IMPLICATIONS FOR A DECISION SUPPORT SYSTEM

THESIS

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AFIT/GEM/LSM/84S-14

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THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

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In Partial Fulfillment of the

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Master of Science in Engineering Management

Mario W. Mastrangeli, B.S.C.E.

Captain, USAF

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Mario Mastrangeli

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Abstract

This investigation identified the decisions and the decision-making styles of the primary managers in Air Force Civil Engineering's Operations Branch. The managers considered were the Chief of Operations and the Chief of Resources and Requirements. Included with this investigation is a discussion of the implications that decisions and decision-making style has for a Decision Support System.

The decisions were identified through the Crawford Slip Method and then categorized by decision type. The decision-making style was defined by the Jungian typology as measured by the Meyers-Briggs Type Indicator. The results determined that the types of decisions in the Operations Branch warrant the support of a Decision Support System. The results also indicated that the managers in the Operations Branch had predictable tendencies towards particular decision-making styles.

A DECISION-ORIENTED INVESTIGATION OF AIR FORCE CIVIL ENGINEERING'S OPERATIONS BRANCH AND THE IMPLICATIONS FOR A DECISION SUPPORT SYSTEM

I. Introduction

Issue

"The mission of the United States Air Force is to organize, train, and equip air forces for the conduct of prompt and sustained combat operations in the air [Contrails, 1979:185]." Air Force Civil Engineering plays a critical role in support of this mission by equipping the Air Force with the necessary facilities. The Civil Engineering mission (AF Engineering and Services Quarterly, 1983) is to "provide the necessary assets and skilled personnel to prepare and sustain global installations as platforms for the projection of aerospace power in peace and war."

In order to manage this mission in a changing environment that is growing in complexity every year it is necessary to adapt to the new environment. As the Honorable Harold Brown (Contrails,1979:187), former Secretary of the Air Force, said in 1966 "The true measure of a professional lies in his ability to adapt to new situations." One way in which today's Civil Engineering Officer can adapt to this high-technology environment is by effectively applying modern technology.

The information and decision-making needs of Air Force Civil Engineering Squadrons are more varied and complex than ever. The proper management of this growing information base in a manner that facilitates decision-making has been a problem brought about by the growing complexity of the high-technology environment. If Air Force Civil Engineering Squadrons are going to manage this information base in an efficient and effective manner they must use the latest technology and procedures.

Much has changed in the information management area in the last twenty years. The progress in this area is primarily due to the improvements in the computer applications area. These improvements had three different phases of emphasis. In the beginning, hardware (the computer itself) was considered to be the most important element when managing information. Then the emphasis shifted to the software (the programs that control the computer) as the driving element. Now the emphasis is being placed on the users of the systems and their ability to receive useful and useable information (Hamill and others, 1983:13).

The key to providing useful and useable information is orienting the information around the decisions and decision-makers. This change is reflected in the latest name for information management systems that are decision oriented. Whereas the older term for information systems

was Management Information Systems (MIS), they are now refered to as Decision Support Systems (DSS). The change in nomenclature from MIS to DSS represents "a natural evolution in computer applications [Keen and Scott Morton, 1978:2]."

In order to explain why this evolution is an improvement it is necessary to define the terms efficiency and effectiveness. "Efficiency is performing a given task as well as possible in relation to some predefined performance criterion. Effectiveness involves identifying what should be done and ensuring that the chosen criteria is the relevant one [Keen and Scott Morton, 1978:7]."

The emphasis in MIS was efficiency; DSS attempts to balance this by also emphasizing effectiveness. The way to make an information system effective is to orient the information to the decision process and present it in a form the decision-maker can use best.

Problem Statement

Air Force Civil Engineering is introducing a modern computer system to be used as a Decision Support System. This new DSS is called the Work Information Management System (WIMS) and will replace the older MIS called the Base Engineer Automated Management System (BEAMS). If the Work Information Management System is to be used effectively, the system must be decision oriented. In order to

be decision oriented, it must consider the decisions and the decision-makers.

The effectiveness of the WIMS depends on the decisions made by the users of the system and the decision-making preferences, or style, of those users. Therefore, there exists a real need within Air Force Civil Engineering Squadrons to identify those decisions and the decision-making style of the managers who make those decisions.

The identification of decisions and the identification of decision-making style of Civil Engineering managers will allow the designers and implementers of the WIMS to make it a system that supports the decisions of the managers who must use the system.

Background

Base Level Civil Engineering. The Base Civil Engineering Squadron is the backbone of Air Force Civil Engineering. Each of the bases' facilities are acquired, constructed, operated, and maintained through the efforts of the Base Civil Engineering (BCE) Squadron. These efforts support Civil Engineering's mission to "provide the necessary assets and skilled personnel to prepare and sustain global installations as platforms for the projection of aerospace power in peace and war [AF Engineering and Services Quarterly, 1983]."

The BCE Squadron is commanded by the Base Civil

Engineer. His organization is divided into seven branches (see figure 1). Four of these branches are considered as being primarily staff or support functions for the Base Civil Engineer: Squadron Section and Administration, Family Housing, Industrial Engineering, and Financial Management. The other three branches are considered primarily line functions: Engineering and Environmental Planning, Fire Protection, and Operations.

Squadron Section and Administration. The responsibilities of Squadron Section and Administration Branch include processing correspondence, maintaining publications, security, training, discipline, and various other duties.

Family Housing. The Family Housing Branch is responsible for managing all activities relating to family housing except furnishings. This includes those families living off base, as well as those living in military housing.

Industrial Engineering. Industrial engineering analysis such as time studies and facility layout plans is the responsibility of the Industrial Engineering Branch. This branch is also the focal point for the present information system BEAMS. The bulk of the responsibility for the development and implementation of the WIMS will probably fall on this branch.

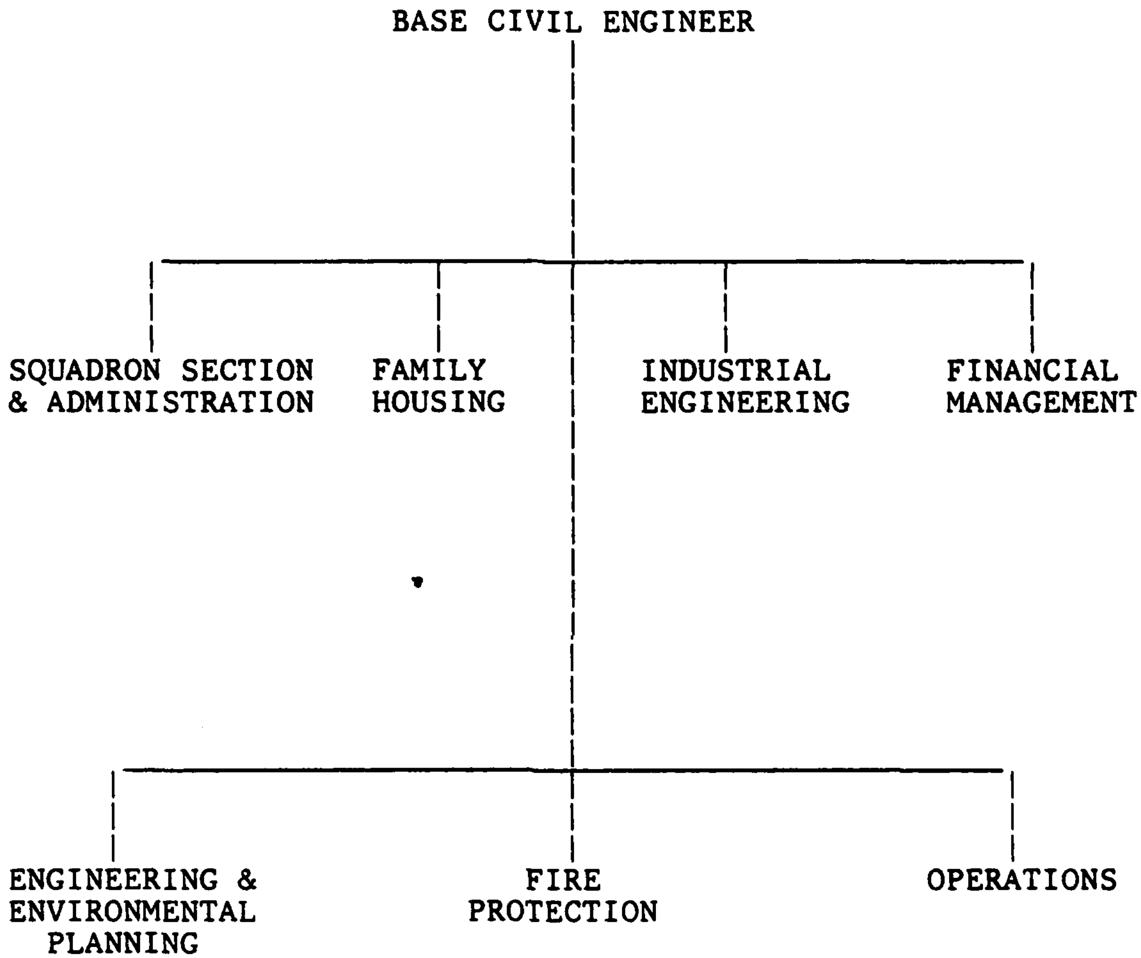

Figure 1. Base Civil Engineering Organization

Financial Management. The role of the Financial Management Branch is to advise the Base Civil Engineer and other managers in matters concerning funding. This branch is responsible for keeping abreast of all matters pertaining to funding. Their primary role is an advisory one.

Engineering and Environmental Planning. The primary responsibility of the Engineering and Environmental Planning Branch is the programming, design, and monitoring of all work that is done by contract. In addition this branch is responsible for environmental, community, and natural resources planning.

Fire Protection. The Fire Protection Branch is responsible for all aspects of fire protection engineering, fire prevention, fire suppression, and fire related rescue operations. The Base Commander is ultimately responsible for the fire protection of the bases resources. However, the Base Civil Engineer is the fire marshal for the base and therefore administers the fire protection program through this branch.

Operations. All of Civil Engineering's craftsmen are assigned to the Operations Branch. Therefore, all of the maintenance, repair, and minor construction performed by squadron personnel is done by this branch. This research will be concentrating on this branch so an in-depth description of the Operations Branch will follow.

Operations Branch. The relative importance of the Operations Branch to the overall Civil Engineering mission is demonstrated by the size of this branch. It is the largest of all the branches.

Organization of the Operations Branch. The Chief of Operations is the branch chief. He supervises the line function, headed by the Superintendents and the Chief of EMCS (Energy Monitoring and Control Systems), and the staff functions, headed by the Chief of Resources and Requirements (see figure 2). The Superintendents are in charge of the work force and are divided up by discipline. For example, the Structural Superintendent is in charge of the carpentry, paint, and plumbing shops; while, the Mechanical Superintendent is in charge of the heating operations, heating maintenance, and refrigeration shops. The Chief of Resources and Requirements is responsible for all of the staff functions.

These staff functions support the in-house work force in various ways. (In-house refers to work done by Civil Engineering's own work force.) The Production Control Section does the programming and scheduling of the in-house work. The Planning Section does the preliminary cost, material, and manhour estimates for the in-house work. Vehicle monitoring and material control are the responsibility of the Readiness and Logistics Section.

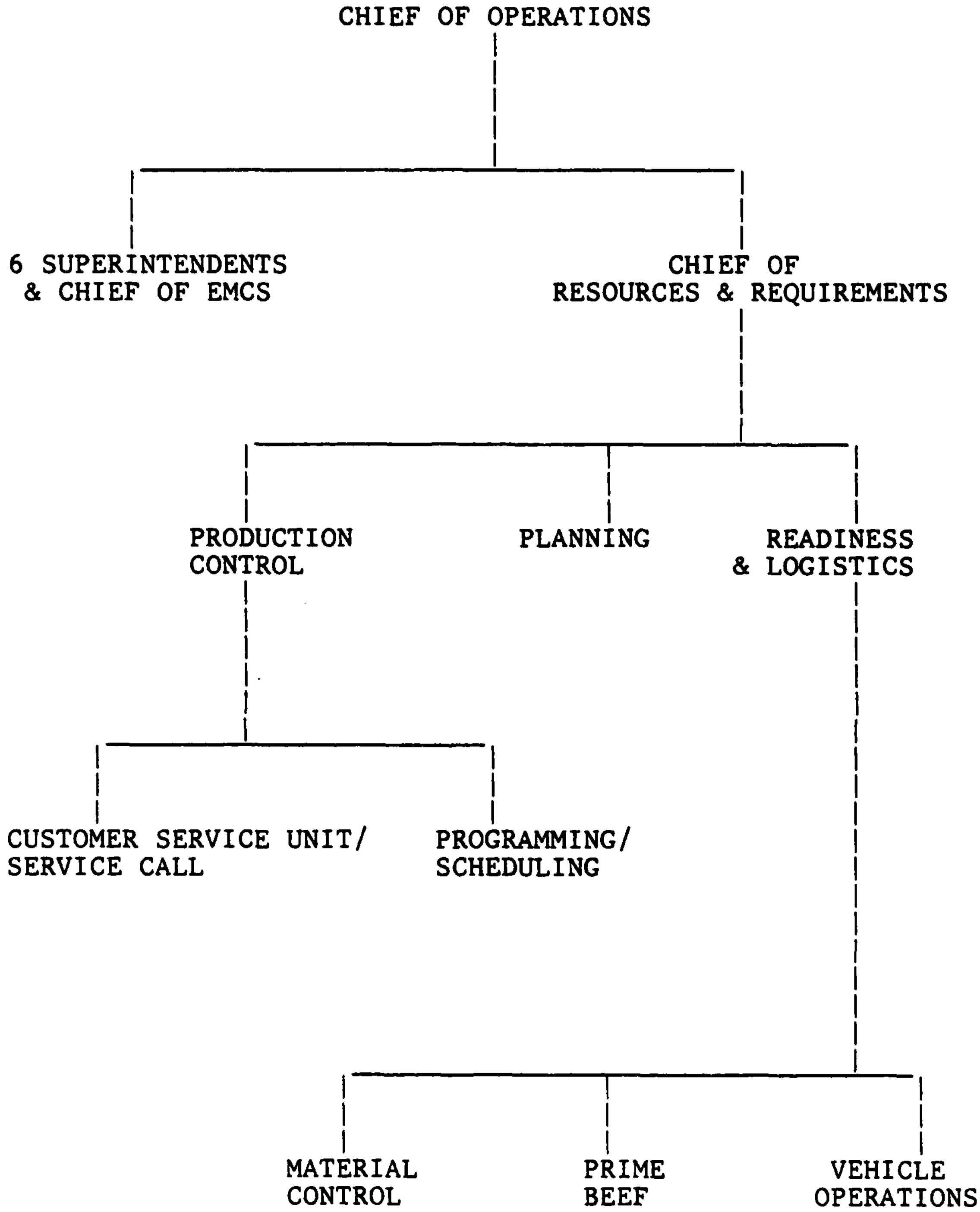

Figure 2. Operations Branch Organization

In-house Work. The in-house work can be divided into job orders and work orders. Job orders are work that is simple in nature and only requires the work of one shop. Job orders are classified as either emergency, urgent or routine. The maximum response time on emergency job orders is 24 hours, on urgent it is 5 days, and on routine it is 30 days. Work orders are more complex than job orders and require either more detailed planning, coordination between shops, or special materials.

The job orders and work orders are scheduled on the In-service Work Plan (IWP) and are then accomplished by the in-house forces. In order to make up the IWP, the information on job orders and work orders presently approved but not already scheduled must be reviewed. With the BEAMS only the work order information is kept on the computer; the job order information is maintained manually. This is one example of the BEAMS not fully supporting the decisions that must be made. The next section describes the present information system and its problems.

Base Engineer Automated Management System. BEAMS has been used by Air Force Civil Enginering since 1969. The idea of the BEAMS for Civil Engineering Squadrons started when Air Force Bases were getting the "phase II" computer system. Civil Engineering (CE) had already been using the "phase I" computer system but did not really have their own system until "phase II" came along. Many of the reports CE

had been using on "phase I" were carried over to BEAMS (Ruff, 1984).

Seven on-line and four off-line subsystems make up the present BEAMS. These subsystems include such items as the Cost Accounting Subsystem and the Material Processing Subsystem. BEAMS is on the central base computer and is connected to the BCE facility by remote terminal. Each BCE Squadron has from one to five terminals to be shared by all personnel.

BEAMS automatically outputs 24 standard reports periodically. These reports, and 60 other standard reports, are also available upon request. Procedure requires these reports to be requested through the Base Data Automation Center. The reports are printed overnight and ready the next day. The centralized control of BEAMS causes inflexibility; the manager who desires a non-standard report must endure a long bureaucratic process to have a chance of receiving approval for the report. Then he must find someone with the computer expertise to write the program necessary to retrieve the information he needs (Ruff, 1984).

Information management on the BEAMS is not efficient. The information must be handled twice: once when the manager decides to update or add a piece of information, and a second time when the information is put in the computer. The time lapse between the managers decision and

the system update presents a problem with the currency of the information. Brigadier General Ellis, the Deputy Chief of Staff, Engineering and Services, Tactical Air Command (Sullivan, 1983:12) made some remarks about the currentness of information.

> I [Gen. Ellis] didn't like it [BEAMS] primarily because it forced us to manage in the past. The only thing BEAMS let us do was look back to see what it was we hadn't done. I coined the phrase "too late management." We needed to manage forward. I felt we could do a much better job if we managed what we had to do, not what hadn't been done.

The time lapse problem along with the system's inflexibility are contributing factors to BEAMS biggest problem, poor acceptance by the users.

BEAMS shortfalls can be summarized by listing its three main problems: lack of flexibility, lack of timeliness, and lack of user acceptance. Three aspects inherent in the system prevent these problems from being remedied. The centralization of the computer, the small number of terminals within the organization, and the low priority assigned to CE by the Base Data Automation Center prevent CE from solving the problems (Ruff, 1984).

Work Information Management System. WIMS was developed to solve the problems inherent in the BEAMS. The computer system will be decentralized,will have thirty to forty terminals spread throughout the squadron, and will be dedicated to Civil Engineering. WIMS is designed to be flexible, timely, and user friendly; therefore, if it

performs as it is designed it will solve the main problems associated with BEAMS.

A WIMS prototype is currently being tested at Tinker AFB; the initial trial period has been successful. Chanute AFB, Davis-Monthan, and Misawa AB are the next bases scheduled to receive WIMS. If the implementation goes as planned, every Air Force Base will be on-line by 1988 (Golondzinger, 1983).

In order to make WIMS as effective an information system as possible, it is necessary to follow the advice of General Ellis and "manage forward." Effectiveness can be maximized by using WIMS to do what needs to be done, not just what hasn't been done in the past. In addition to correcting the problems found in BEAMS, WIMS is supposed to support the decisions of the users. WIMS can move beyond just being a Management Information System and can become a Decision Support System.

MIS versus DSS. This change in nomenclature from Management Information Systems (MIS) to Decision Support Systems indicates a corresponding change in emphasis. The emphasis shifts from the system efficiently storing and retrieving data to the system effectively supporting the decision making activities of the manager. In actuality, the emphasis changed even before the name changed; as early as 1979 Zmud (1979:968) stated that the organizational role of a MIS is to support decision making activity.

Bennett, (1983:178) defines MIS as "a system with predefined data aggregation and reporting capabilities. MIS reports are usually either printed in batch or queried on demand." The same person (Bennett, 1983:179) describes DSS as "an extensible system with intrinsic capability to support ad hoc data extraction, analysis, consolidation, and reduction, as well as decision-modeling activities."

An information system cannot be considered a DSS unless the managers get involved. Therefore, shifting to DSS has changed the role of the manager with respect to the computer system. The manager must transition from a passive receiver of reports, to an active user of an automated system. Without this transition the system cannot support the managers' decisions (Keen and Scott Morton, 1978:13-15).

Now the focus is on the decisions and the decision makers. However, each decision maker is different and these differences can affect the interaction with the DSS. The decision makers are different in style, skill, and knowledge; the DSS should help the decision makers use and develop these differences (Bennett, 1983:19). If this is done, "the cost effectiveness of DSS should improve because several decision makers could make effective use of the same DSS [Bennett, 1983:19]."

Decision Style. The decision style of managers has many different names: cognitive style, thinking style,

decision-maker style, personality, and psychological type, just to name a few. The term "decision style" will be most often used in this paper when referring to the decision makers style.

Cognitive or Decision styles "represent characteristic modes of functioning shown by individuals in their perceptual and thinking behavior [Zmud, 1979:967]." Decision style is the style in which a person perceives and processes information.

According to one program for research on information systems (Mason and Mitroff, 1973:476), an information system is composed of five things:

1) a **PERSON** of a certain **PSYCHOLOGICAL TYPE**
2) who faces a **PROBLEM**
3) within some **ORGANIZATIONAL CONTEXT**
4) that needs **EVIDENCE**
5) thru some **MODE OF PRESENTATION**

These components have many complex interrelationships and this research will only begin to scratch the surface in conveying some of these relationships.

This research will concentrate on the person and his psychological type, or decision style. As the list indicates, the person's behavior depends on the problem he faces and on the context within which he faces it. However, individuals have a "pervasive" tendency toward a particular cognitive behavior (Zmud, 1979:967).

There is a tie between what the DSS is supposed to do and decision style. The DSS must gather data or information and then process it. This is very similiar to the

perceiving and processing modes of functioning that are associated with decision style. If the DSS method of acquiring data and processing information approximates the individual's style of perceiving and processing information, then the DSS and the individual are considered to be matching.

If the individual and the DSS don't match, then problems may result from these differences. If there is a difference in the mode of acquiring information then there will be a disparity in what the DSS outputs as information and what the individual considers to be information. What is information for one style of individual will not necessarily be information for another style. Therefore, it is important to give each individual the kind of information that fits his decision style and he can use most effectively (Mason and Mitroff, 1973:476).

The modes of processing information of the DSS and the individual should also match. If the method that the DSS uses to manipulate data differs from the way the individual processes his information, then he will be less likely to use the system. One research team (Robey and Taggart, 1981:188) felt that human information processing styles are quantitatively different. "Some decision makers use logical routines to make decisions and are classified as analytical or systematic. Their nonlogical counterparts

use unsystematic, intuitive processes to reach decisions [Robey and Taggart, 1981:188]."

Research on decision style has brought out the need to match the design of a DSS to the individual needs, processes, and capacities of the user (Keen and Scott Morton, 1978:50). Other researchers (Henderson and Nutt, 1980:385) agree with Keen and Scott-Morton in arguing that style is an important thing to consider when designing a DSS. Henderson and Nutt "feel that knowledge of how individual style may influence managerial behavior during the decision process will provide foundations for increasing the effectiveness of the management scientist [who develops the DSS] [Henderson and Nutt, 1980:385]."

In the past there have been problems because the management scientists have designed the DSS to duplicate their ideas on gathering and processing information. They did not believe there was a need to change the way they developed the systems because they considered their way the best way. It is usually assumed management scientists tend to be systematicly oriented and managers tend to be intuitively oriented (Bostrom and Kaiser, 1982:44). Others (McKenney and Keen.1974:87) examine an important alternative: "to stress that the intuitive mode is not sloppy or loose; it seems to have an underlying discipline at least as coherent as the systematic mode, but it is less apparent because it is largely unverbalized."

Since there is no superior decision style, we must consider how to accommodate all of the different styles with an information system to make it as effective as possible. This research attempts to explore the decision styles of managers as a first step towards an effective Decision Support System.

Scope and Limitations

This research will provide information that is prerequisite for orienting the new Work Information Management System towards the actual decisions and decision makers who will use the system. The research will be aimed at the Operations Branch within Base Civil Engineering Squadrons. The Operations Branch was chosen because it is the largest branch in Base Civil Engineering. The research focuses on the two primary managers within the Operations Branch, the Chief of Operations and the Chief of Resources and Requirements. Due to cost and time constaints only Air Force Bases within the continental United States were considered in this research.

Research Objectives

The objectives of this research are twofold:

1. Identify the decisions made by the two primary managers within Civil Engineering's Operations Branch.

2. Identify the decision styles of the two primary managers within Civil Engineering's Operations Branch.

<u>Research Questions</u>

1. What are the implications for DSS suggested by the identification of the decisions of the two primary managers within Civil Engineering's Operations Branch?

2. What are the implications for DSS suggested by the identification of the decision styles of the two primary managers within Civil Engineering's Operations Branch?

II. Literature Review of Decision Types and Decision Styles

The first section reviews the literature on classifying decisions into different decision types. The following six sections review different authors' frameworks for describing decision style. Then the last section analyzes and applies decision style literature for use in a Decision Support System.

Decision Type

One of the first attempts at classifying decisions divided them into two categories, programmed and nonprogrammed (Simon, 1960:5-6). Simon described programmed decisions as decisions that are repetitive and routine in nature. He said that programmed decisions lend themselves to a definite solution procedure. Nonprogrammed decisions are novel and unstructured; no specific procedure has been developed to handle them (Simon, 1960:5-6).

Keen and Scott Morton (1978:86) prefer the terms structured and unstructured "because they imply less dependence on the computer and relate more directly to the basic nature of the problem solving activity in question [Keen and Scott Morton, 1978:86]." They also add a middle classification called semistructured that are partly structured and partly unstructured.

Structured decisions occur in situations where the decision procedure is understood well enough that the manager does not need to be involved. Typically, these decisions are relegated to subordinates or are automated by computer systems. Examples of structured decisions are inventory ordering and production scheduling.

Unstructured decisions are the opposite of structured decisons; their decision procedure is not understood. Unstructured decisions either do not exhibit a structure or do not appear to exhibit a structure. Complex social policy decisions and employee hiring decisions are examples of unstructured decisions.

Semistructured decisions are a cross between structured and unstructured decisions. They occur when the managers judgment alone is not enough, due to the size or complexity of the problem. However, these decisions also require some sort of subjective analysis that makes the involvement of the manager necessary. Examples of these type decisions are stock trading and setting market budgets.

It is in the area of semistructured decisions that Decision Support Systems can be the most effective. "Support implies that the first stage in DSS development be decision analysis, with the manager defining the key decision problems [Keen and Scott Morton, 1978:97]." Once the semistructured problems are identified they can be

analyzed separately and broken into parts that the computer can do, and parts that manager must do (Keen and Scott Morton, 1978:86-88,97).

Byrd and Moore's Decision Style

Byrd and Moore provide a very simple framework for describing decision style. This framework describes decision style in terms of propensity to avoid or accept risk. This framework has only one dimension with risk avoiders at one extreme and risk takers at the other. (see figure 3)

RISK AVOIDER--------------+-----------------RISK TAKER

(propensity to accept risk)

Figure 3. Risk Propensity Model

The risk avoiders would require as much information as possible to avoid as much risk as possible; while, the risk takers do not need as much information since they are willing to accept more risk (Byrd and Moore, 1982:137).

Huysmans' Decision Style

Huysmans proposed a one dimensional framework which identified unique "ways of reasoning" called analytic and heuristic (Huysmans, 1970:94-95). At one end of the spectrum is analytic reasoning which emphasizes relationships; at the other end is heuristic reasoning which emphasizes pragmatic solutions. (see figure 4)

```
 ANALYTIC_______________+_______________HEURISTIC
REASONING                               REASONING

 emphasizes                          emphasizes
relationships                   pragmatic solutions
```

Figure 4. Huysmans' Reasoning Model

Analytic Reasoning. The person who uses analytic reasoning reduces the problem and its situation to a "set of underlying causal relationships [Huysmans, 1970:95]." The primary method of problem solving is the use of relationships to manipulate variables to arrive at some "optimal solution." An analytic individual often forms an explicit model from these relationships and usually bases his decision on this type of model.

Heuristic Reasoning. In heuristic reasoning, the user emphasizes the use of pragmatic solutions. A heuristic

individual solves problems by comparing the present problem with similiar problems that he already has a solution to. The goal in heuristic reasoning is usually a satisfactory solution, rather than an optimal solution.

These descriptions are meant to characterize the two extremes of the reasoning model (figure 4). An individual has a tendency to reason that is located somewhere along the continuum, not just at the extremes (Huysmans, 1970:94-95).

Witkin's Decision Style

As a one dimensional model, Witkin's decision style is based on the concept of field independence. Field independence is the *ability, or* inclination, to separate an object or occurrence from its environment. The two extremes are field dependence and field independence. As in Huysmans' model an individual may fall anywhere along the continuum. (see figure 5)

```
  FIELD                                    FIELD
DEPENDENT----------------+----------------INDEPENDENT
```

(inclination to separate object from its environment)

Figure 5. Witkin's Field Independence Model

Field Dependent. Individuals who are field dependent are inclined to view the object or occurrence with its environment. Their global approach results in an intuitive problem solving method.

Field Independent. Because the field independents separate the object from its surroundings, they are considered to prefer problem solving methods that require attention to detail. Their tendency is to deal only in basic relationships (Henderson and Nutt, 1980:372).

Driver and Mock's Decision Style

"Cognitive complexity refers to an individual's capacity to handle complexity in information when making a decision [Szilagyi and Wallace, 1983:320]." Driver and Mock used cognitive complexity ideas to develop this two dimensional framework. One dimension descibes the individual as having either a single or multiple focus in considering information pertaining to the decision. An individual with a single focus would be satisfied with information from only one source. While, an individual with a multiple focus would prefer more sources of information. The other dimension describes the amount of information considered in making the decision. Four independent styles are defined by this model (Szilagyi and Walace, 1983:320-321). (see figure 6)

TYPE OF FOCUS

AMOUNT OF INFORMATION USED		Single	Multiple
	Low	**decisive**	**flexible**
	High	**hierarchic**	**integrative**

Figure 6. Cognitive Complexity Model (Szilagyi and Wallace, 1983:321)

<u>Decisive Style</u>. The decision-maker with decisive style uses a small amount of information and uses a single focus when making a decision, or solving a problem.

<u>Hierarchic Style</u>. A hierarchic style decision-maker prefers to gather and use as much information as possible. However, he still will have a single focus when he processes this large amount of information.

<u>Flexible Style</u>. A decision-maker with flexible style only acquires a small base of data for his decision. Then, he uses multiple focuses when processing the information.

<u>Integrative Style</u>. This style decision-maker, like the hierarchic style, employs a large amount of information. However, he processes this information with a multiple focus approach (Szilagyi and Wallace, 1983:320-321).

McKenney and Keen's Decision Style

These authors proposed a two dimensional framework for describing decision style. One dimension, called information gathering, "relates to the essentially perceptual processes by which the mind organizes the diffuse verbal and visual stimuli it encounters [Keen and McKenney, 1974:80]." The two extremes of this dimension refer to the mode of gathering information and are called perceptive and receptive.

The other dimension, called information evaluation, "refers to processes commonly classified under problem solving [Keen and McKeeney, 1974:81]." The two extremes of this dimension refer to the mode of evaluating information and are called "systematic" and "intuitive." (see figure 7)

Information Gathering Dimension.

Perceptive Individuals. The perceptive individual uses concepts to gather and filter data. These concepts can take the form of relationships or explanatory models. They use these concepts to compare what they actually perceived to what they expected to perceive.

Receptive Thinkers. Receptive thinkers tend to focus on the details instead of the relationships. More sensitive to the actual stimuli, they try to derive relationships from the data without first considering what they expected to find.

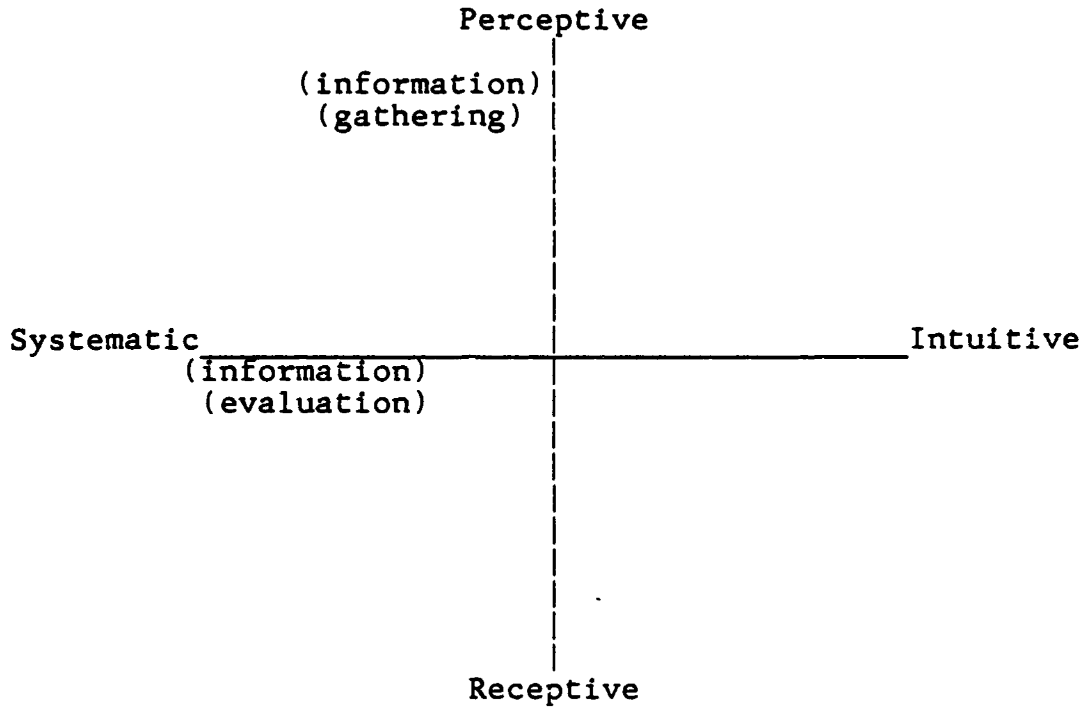

Figure 7. McKenney and Keen's Decision Style Model (Keen and McKenney, 1974:80)

Information Evaluation Dimension.

Systematic Individuals. These systematic individuals will try to approach a problem by structuring it in such a manner that the application of a proper method will result in a viable solution.

Intuitive Thinkers. Unlike systematic individuals, intuitive thinkers tend not to structure a problem. "Their strategy is more one of solution testing and trial and error. They are more willing to jump from one method to another, to discard information, and to be

sensitive to cues that they may not be able to identify verbally [Keen and McKenney, 1974:81]."

"The levels of the two dimensions are seen as independent and nondominating [Henderson and Nutt, 1980:372]," and form four separate decision styles:

SYSTEMATIC-PERCEPTIVE
SYSTEMATIC-RECEPTIVE
INTUITIVE-PERCEPTIVE
INTUITIVE-RECEPTIVE

McKenney and Keen use the term "style" to emphasize that "modes of thinking relate more to propensity than to capacity [Keen and McKeeney, 1974:82]." They feel that there is no style that is superior (Keen and McKenney, 1974;Henderson and Nutt, 1980:372).

Mason and Mitroff's Decision Style

This framework uses the Jungian typology to describe decision style. It, like the McKenney and Keen framework, is two dimensional. The two dimensions are "information acquisition" and "modes of data processing." The information acquisition dimension has two extremes, with the "sensation" oriented individual at one end and the "intuitive" individual at the other. The second dimension divides the extremes of modes of data processing into "feeling" and "thinking" individuals. (see figure 8)

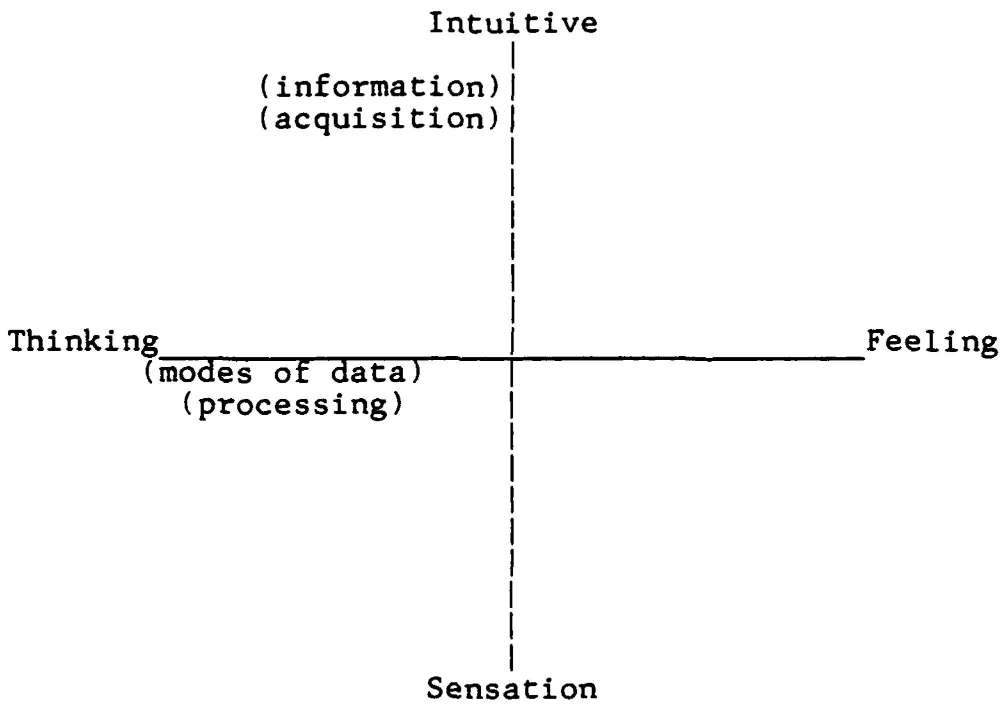

Figure 8. Mason and Mitroff's (Jungian) Model

<u>Information Acquisition Dimension</u>.

<u>Intuitive Individuals</u>. Intuitive individuals see the big picture. Rarely concentrating on isolated elements, they view the entire situation. These individuals prefer to solve unstructured problems and dislike detailed work.

<u>Sensation Oriented Individuals</u>. Sensing people prefer to solve structured problems. They are usually able

to do precise work well because they concentrate on each little detail.

Data Processing Dimension.

Feeling Individual. Feeling people rely on their values to evaluate information. They consider their individual feelings and emotions more heavily than a thinking individual.

Thinking Individual. Thinking individuals rely on their logic to evaluate information. They are impersonal and use practical logical analysis in decision making.

These dimensions are independent, and when considered together form four decision styles:

INTUITIVE-THINKING
INTUITIVE-FEELING
SENSATION-THINKING
SENSATION-FEELING

Each style has particular strengths and weaknesses, but none of them are thought to be universally superior (Henderson and Nutt, 1980:372-373).

Literature Analysis and Application

The last six sections have described different frameworks that attempt to define decision style. The first three frameworks are one dimensional, and the last three are two dimensional. In comparison these frameworks share some similarities. McKenney and Keen's dimensions

(information gathering and information evaluation) parallel Mason and Mitroff's dimensions (information acquisition and modes of data processing).

Two separate dimensions that are similiar are Witkin's field dependent/independent dimension and Driver and Mock's single/multiple focus dimension. Also, Huysmans' analytic/heuristic dimension, McKenney and Keen's information evaluation dimension (systematic/intuitive), and Mason and Mitroff's information acquisition dimension (sensation/intuitive) describe similiar characteristics. Finally, McKenney and Keen's information gathering dimension (perceptive/receptive) and Mason and Mitroff's modes of data processing dimension (thinking/ feeling) suggest similiar ideas. However, it must be pointed out that even though these dimensions are similiar there are subtle differences between the meanings of the words that describe the dimensions.

These frameworks also have marked differences. For example, Mason and Mitroff's framework puts the sensation/ intuitive charateristics on the information acquisition dimension while McKenney and Keen's framework places the similiar systematic/intuitive characteristics on the information processing dimension.

Now that the different decision styles have been discussed the link between decision style and information systems will be analyzed.

"The limitations and other peculiarities of human cognition provide numerous opportunities for MIS designs to aid the user in task accomplishment [Zmud, 1979:970]." This quote characterizes one view of the importance of decision style as it applies to Decision Support Systems. Those who believe in this view feel that the DSS should, in some way, make up for the inherent weaknesses of the user's decision style.

Another view is that the design and implementation of the DSS should match the decision style of the individual using the system. In this theory the management scientists who design and implement the DSS must analyze the cognitive nature of the users of the system. Then, they must develop models that will "amplify and complement [Keen and McKenney, 1974:85]" the decision style of the system's users (Huysmans, 1970:102; Keen and McKenney, 1974:85).

McKenney and Keen (Keen and McKenney, 1974:85) state that in general computer systems are designed by systematic individuals for systematic users. They feel this mismatch between designers and users can cause problems. They mention the "have technique will travel" trap that many management scientists fall into. These analysts find a technique that is effective in one situation and they try to apply it universally without regard for decision style. This approach dampens the effectiveness of the DSS, due to a failure to consider decision style.

The analysis of the literature on the influence of individual differences, such as decision style, upon DSS success indicates that these differences strongly affect DSS success. However, it is apparent that much is still unknown regarding the "specific relationships" involved and the relative importance of these differences (Zmud, 1979:975).

The probable reason for the relationship between decision style and DSS success is the necessity to match the decision style of the manager with the processes of the model he is using. "If we want a manager to use a model we should make it his, an extension of his ability to think about and analyze his operation [Byrd and Moore, 1982:35]." The model should provide the decision-maker with insights about the decision in a way that enhances his decision making capability (Byrd and Moore. 1982:35).

There are many different frameworks that attempt to describe and define decision style, each both succeed and fail. All of them succeed to give us insights into the very complex nature of decision style. They also fail because none of them can possibly define the extremely complex nature of decision style.

The implications that decision style has for DSS is not a completely known area either. Some people have tried to apply some of the frameworks, but there is a lot more

research that can be done. The ending quote sums up this idea.

> If decision approach is an important information system design variable, further research is needed to develop a taxonomy of relevant decision-maker characteristics. Certainly given the capabilities of modern computer-based accounting systems, individualized information systems are feasible. (Vasarhelyi, 1977:151)

III. Methodology

This chapter presents the methodology employed to fulfill the research objectives. The two research objectives are reviewed then the sample, data collection, and data analysis procedures are discussed. All three discussions address both objectives, since the two objectives are distinctly different from each other.

Review of Research Objectives

The dual objectives of this research were designed to lay the foundation for the use of WIMS in a decision support role in the management of the Operations Branch of an Air Force Civil Engineering Squadron.

Identify Decisions. The first objective of this research is to identify the decisions made by the two primary managers of Civil Engineering's Operations Branch. These managers are the Chief of Operations and the Chief of Resources and Requirements.

Fulfillment of this objective was necessary because before a DSS can be used effectively the decisions of the system's users need to be identified.

Identify Decision Styles. The second objective is to identify the decision style of these same managers. The

identification of decision style will describe the ways in which the two managers acquire and process information.

It was necessary to identify the decision style of these managers because the way they acquire and process information affects the way in which the DSS can support their decisions.

Population and Sample

This research deals with two populations. One population is the set of all present and future Chiefs of Operations. The other is the set of all present and future Chiefs of Resources and Requirements. In some cases these populations are combined to establish the set of all present and future primary managers of the Operations Branch.

The two research objectives were attained using distinctly different techniques; therefore, it was necessary to use a different sample for each research objective.

Identify Decisions. Data for the identifying of decisions was obtained from Chiefs of Operations and Chiefs of Resources and Requirements attending the Operations Management Applications Course (MGT 430) at the Air Force School of Civil Engineering.

A total of fourteen Chiefs of Operations and fifteen Chiefs of Resources and Requirements were polled. These managers were polled at three separate MGT 430 classes: 6-17 Feb 1984, 2-13 Apr 1984, and 14-25 May 1984.

These classes were chosen as a focal point because they are a ready source for getting in contact with many Chiefs of Operations and Chiefs of Resources and Requirements at one location. These classes are composed of managers of the Operations Branch from many different Air Force Bases, providing a knowledgable and diverse group from which to draw data. The responses of each sample are assumed to be representative of their respective populations. The basis for this assumption is the fact that within each population the managers perform the same duties and therefore make similiar decisions.

Identify Decision Styles. The sample used to identify the decision styles was the set of all Chiefs of Operations and all Chiefs of Resources and Requirements at bases in the Continental United States (CONUS) that had both job positions.

A total of 156 surveys were sent to 78 Chiefs of Operations and 78 Chiefs of Resources and Requirements and 122 were returned, 64 from Chiefs of Resources and Requirements and 58 from Chiefs of Operations.

The sample was limited to the CONUS because of time and money constraints. The 156 bases included in the survey are all the bases in the CONUS that have a position for a Chief of Operations and a Chief of Resources and Requirements.

Data Collection

The diverse nature of the two research objectives led to the adoption of a two pronged data collection plan. This section presents the data collection method and procedure used for each research objective. Background on each of the methods are also included.

Identify Decisions. The method this research uses to identify the decisions made by the population is the Crawford Slip Method (Crawford and Demidovich, 1983). This method draws out knowledge from those who posess it so that it can be shared and put to use. As T. Ross Clayton (Crawford and Demidovich, 1983) wrote in the foreward to The Crawford Slip Method, "Few management technologies in use today have the potential that is inherent in the slip method as an instrument for orchestration of the knowledge which exists in the minds of organizational members."

The Crawford Slip Method is a simple method. The first step involves gathering the people who have the needed information. Then those people use numerous uniform slips of paper to write down their ideas on the area in question. The ideas should be written in a short sentence format, and only one sentence per slip.

As a systems analysis tool this method can be applied to a variety of situations. The identification of the decisions of these two managers is an example of reducing

the unknowns. In this case the unknowns are the actual decisions that the two managers make.

The managers attending the Operations Management Application Course at the Air Force Institute of Technology's School of Civil Engineering were chosen because they are an accessible group with the knowledge that was needed for this research.

The actual procedure used in this research was a modification of the Crawford Slip Method. Because, the class is made up from different managers in the Operations Branch, it was necessary to be able to identify which managers were making which inputs. Instead of having the subjects write their job title on many small slips, one larger (8½x5½) slip with the subjects job title on it was used.

The use of one larger slip will make the processing and organizing of the results more difficult; however, this is a trade off that is not too costly since a small sample (29 managers) is being used.

Identify Decision Style. The decision style framework used for this research is the one espoused by Mason and Mitroff (Henderson and Nutt, 1980:372-373). They used the Jungian typology (Jung, 1923) to classify decision style. The measurement and classification according to the Jungian typology is accomplished by using the Myers-Briggs Type Indicator (MBTI) (Myers, 1963).

The Jungian typology as measured by the MBTI was chosen because of its growing research base (Henderson and Nutt, 1980; Kilmann and Mitroff, 1976; Kaiser and Bostrom, 1982; Mason and Mitroff, 1973; McCaulley and others, 1983; Robey and Taggart, 1983). Additionally, it has been found to have reasonable reliability (Carlyn, 1977; Lake and others, 1973; Stricker and Ross, 1963). One review of the MBTI stated "Results of the studies indicate that the Meyers-Briggs Type Indicator is an adequately reliable self-report inventory" (Carlyn, 1977:461).

The MBTI instrument measures the four preferences found in Jungian typology. The scales measure four preferences: Extraversion - Introversion (E-I), Sensation - Intuition (S-N), Thinking - Feeling (T-F), and Judgement - Perception (J-P). Each of these preference scales are supposed to be independent of one another. However, studies (Carlyn, 1977:462) consistently show that the S-N scale and the J-P scales have a significant correlation; judging types tend to be sensative and perception types tend to be intuitive.

If this is true then the MBTI measures three scales that are independent of each other: E-I, S-N, and T-F. The MBTI also measures one scale, J-P, that is probably related to the S-N scale. This characteristic seems to back up Jung's original typology which did not explicitly include

the J-P scale. The judging and perceptive types were only implied in Jungian theory.

To determine the person's preference in each of the four scales the MBTI has forced-choice questions. One answer is weighted to one of the eight preferences and the other answer is weighted to the opposite preference. The points for each preference are compiled, resulting in eight scores which are considered as four matched pairs. The larger of each pair indicates the preference. For example, a thinking (T) score of 17 and a feeling (F) score of 3 would mean that person is a thinker since the thinking score is higher than the feeling score.

This type of comparison is done for all four scales. The results will indicate the person's preference on each scale. There are 16 different types possible:

ISTJ	ISFJ	INFJ	INTJ
ISTP	ISFP	INFP	INTP
ESTP	ESFP	ENFP	ENTP
ESTJ	ESFJ	ENFJ	ENTJ

In order to identify the decision style of all the managers in the sample, one MBTI question booklet and one answer sheet was sent to each Chief of Operations and each Chief of Resources and Requirements. All CONUS Air Force bases that had both a Chief of Operations and a Chief of Resources and Requirements were included in this mailing.

Both of these managers took the MBTI and returned the blank question booklets and completed answer sheets to be scored.

Data Analysis

The analysis of the data collected is descriptive in nature. Both of the research objectives deal with identification. This section presents the data analysis procedures used to: 1) identify the decisions made by the Chief of Operations and the Chief of Resources and Requirements and 2) identify the cognitive styles of the Chiefs of Operations and the Chiefs of Resources and Requirements.

Identify Decisions. The decisions identified by the Chiefs of Operations and the Chiefs of Resources and Requirements were divided into the three decision types:

Structured Decision Types

Semistructured Decision Types

Unstructured Decision Types.

Identify Decision Styles. Once the completed MBTI answer sheets were returned they were graded by hand with an answer key. The two samples are described in three ways.

1) along each scale

Extraversion(E)----Introversion(I)
Sensation(S)----Intuition(N)
Thinking(T)----Feeling(F)
Judgement(J)----Perception(P)

2) by two letter type

ST	SF	NF	NT

3) by four letter type

ISTJ	ISFJ	INFJ	INTJ
ISTP	ISFP	INFP	INTP
ESTP	ESFP	ENFP	ENTP
ESTJ	ESFJ	ENFJ	ENTJ

IV. Findings and Analysis

This chapter presents and analyzes the findings of the two pronged data collection plan outlined in Chapter III. The findings for each research objective are presented and analyzed.

Identification of Decisions

Chief of Resources and Requirements. The 15 Chiefs of Resources and Requirements who took part in this phase of the research identified 35 different decisions that they made while carrying out the duties of their job. Of the 35 decisions identified, 18 were listed by two or more of the individuals. These 35 decisions, and the number of times each decision was listed, are in Appendix A.

None of the decisions identified were unanimously chosen by all 15 of the Chiefs of Resources and Requirements. However, two of the decisions were listed by over 60% of them. They dealt with deciding whether to accomplish the work by contract or by in-house forces, and approving or disapproving work requests.

Chief of Operations. The 14 Chiefs of Operations who took part in this phase of the research identified 43 different decisions that they made while carrying out their duties. These 43 decisions are listed in Appendix B.

Eighteen of the 43 decisions were listed by at least two of the individuals taking part in this portion of the research.

There is even less agreement on the decisions identified by the Chief of Operations than those identified by the Chief of Resources and Requirements. The most commonly listed decision was listed by 6 (43%) of the 14. It dealt with determining if work should be accomplished by contract or in-house forces. The only other decision listed by more than 30% of the Chiefs of Operations was a decision on how to prioritize work.

Analysis of Decisions

The analysis of the decisions identified in this research is based on the decision types identified in chapter II. The decisions fall into one of the three decision type categories, either structured, semistructured, or unstructured.

The structured decisions are so organized and well understood that the involvement of the manager is not necessary. In semistructured decisions, the manager's judgment alone cannot handle the task and the computer alone cannot handle it because some judgment is necessary. The manager can make the best decision by balancing his judgment with the computer's capacity to perform intricate computations quickly and accurately. The unstructured

decisions are those that defy structure or appear to have no structure. These decisions are usually left to the manager to solve with his judgment and intuition (Keen and Scott Morton, 1978:86).

Chiefs' of Resources and Requirements Decisions. Of the 35 decisions identified by the Chiefs of Resources and Requirements, 2 (6%) were structured, 28 (80%) were semistructured, and 5 (14%) were unstructured. Tables I, II, and III show which decisions were placed in each category.

TABLE I

Chiefs' of Resources and Requirements
Unstructured Decisions

- Decide if more information is needed before a decision can be made.
- Decide which employee to nominate for awards.
- Decide what should be briefed to a higher level.
- Decide on ratings for subordinates.
- Decide whether to question subordinates' decision or wait to see outcome.

TABLE II

Chiefs' of Resources and Requirements
Structured Decisions

- Decide on vehicle rotation.
- Decide when and how many appliances to order.

TABLE III

Chiefs' of Resources and Requirements
Semistructured Decisions

- Decide best method to accomplish work, either through job order, work order, or contract.
- Decide to approve or disapprove work requests.
- Decide on In-service Work Plan (IWP) schedule.
- Decide how to schedule command interest work.
- Decide how to get materials, either base supply or local purchase.
- Decide how to classify work [mission essential or nice to have].
- Decide to approve or disapprove walk through for materials.
- Decide on planning schedule.
- Decide if the squadron has the resources and skills to do the work.
- Decide which work centers need management attention.
(continued)

TABLE III (cont)

- Decide what goes on recurring maintenance plan.
- Decide on work priorities for planning and materials.
- Decide what jobs Prime BEEF will accomplish.
- Decide on approving and scheduling employee leave.
- Decide best way to use computer terminal time.
- Decide how to accomplish command interest work.
- Decide on how to estimate work requirements for 5 year maintenance and repair plans.
- Decide how to reduce planning backlog.
- Decide how to rate efficiency of method of accomplishing work.
- Decide what the long range effects of a decision could be.
- Decide when to authorize overtime.
- Decide proper sequence to handle high priority work.
- Decide whether to release a work order before it is material complete.
- Decide on prioritizing vehicles for maintenance.
- Decide on priority of typing requirements.
- Decide on which supplies and equipment to buy when money is tight.
- Decide who does work planning [planning section or shops].
- Decide on best way to use manpower.

Chiefs' of Operations Decisions. The Chiefs of Operations identified 43 decisions. None of these decisions were classified as being structured. However, 32 (74%) were classified as semistructured and 11 (26%) were considered to be unstructured. Tables IV and V list the decisions by the decision type, either semistructured or unstructured.

TABLE IV

Chiefs' of Operations
Unstructured Decisions

- Decide who to recognize with awards.
- Decide how to resolve interpersonal conflict at the supervisory level.
- Decide who to send to meetings.
- Decide how to prioritize job vacancies.
- Decide how to accomplish cathodic protection maintenance without additional personnel.
- Decide if issue needs to be sent to a higher level.
- Decide who would be the best person to correct a specific problem.
- Decide on a rating for a subordinate.
- Decide on internal reassignment of personnel.
- Decide how to resolve intershop conflicts.
- Decide on disciplinary measures.

TABLE V

Chiefs' of Operations
Semistructured Decisions

- Decide how work will be accomplished [in-house versus by contract].
- Decide how to prioritze work.
- Decide to approve or disapprove work request.
- Decide on vehicle allocation [size/distribution].
- Decide if shops are working at their expected productivity level.
- Decide what the overhire requirements are.
- Decide how to prioritize command interest items.
- Decide which jobs to "slip" backward in In-service Work Plan [IWP].
- Decide which jobs to concentrate material requisitioning efforts on.
- Decide how to schedule work for the In-service Work Plan [IWP].
- Decide to approve or disapprove overtime.
- Decide which Minor Construction (MC) work to defer if we are going over the 5% MC limit on in-house manhours.
- Decide whether to approve or disapprove high cost purchases or equipment rentals.
- Decide what percentage of direct manhours should be held back for contingencies.
- Decide if we should go contract on certain large work orders.
(continued)

TABLE V (cont)

- Decide on the best way to order supplies.
- Decide which crisis needs immediate attention.
- Decide whether to emphasize quality or quantity.
- Decide which Prime BEEF team to recall.
- Decide whether to make a long term repair or a short term fix.
- Decide how to prioritize equipment purchases.
- Decide the best way to reduce the work backlog in specific shops.
- Decide on the best method of tracking work requests.
- Decide which equipment to shut off when electricity is cut back.
- Decide if work is being done as planned.
- Decide if work is being accomplished as scheduled.
- Decide if Prime BEEF program is being properly accomplished.
- Decide whether to fix or replace high value items.
- Decide whether a problem is chronic or an isolated case.
- Decide on a personal daily schedule.
- Decide on the requirements for base exercises.
- Decide what the training requirements are.

Summary of Semistructured Decisions

This section summarizes the 60 semistructured decisions identified by both managers (28 Chief of Resources and Requirements; 32 Chief of Operations). Since semistructured decisions are best supported by DSS, these decisions represent the basis from which to start further research in the DSS area. The semistructured decisions of both managers were placed into one of five categories of managerial decisions: scheduling decisions, material/supply decisions, prioritizing decisions, programming decisions, or general managerial decisions.

The largest category of decisions was the general managerial decisions. In total 21 decisions within the Operations Branch fell in this category. It was also the largest category for the Chiefs of Operations; 15 of their decisions were in this category. Six of the Chiefs' of Resources and Requirements Decisions were categorized as general managerial decisions.

The largest decision category for the Chiefs of Resources and Requirements was the programming decisions category. Ten of the Chiefs of Resources and Requirements decisions fell in this category. The programming decisions category was the second largest overall (16 decisions), and the second largest for the Chiefs of Operations (6 decisions). Table VI shows the breakout of all the semistructured decisions by category and manager.

TABLE VI

Chiefs of Resources and Requirements and
Chiefs of Operations Decisions by Category

DECISION CATEGORY	CHIEF OF RES. & REQ	CHIEF OF OPERATIONS	COMBINED
MATERIAL/SUPPLY DECISIONS	4 (14%)	3 (9%)	7 (12%)
PRIORITIZING DECISIONS	3 (11%)	4 (13%)	7 (12%)
SCHEDULING DECISIONS	5 (18%)	4 (13%)	9 (15%)
PROGRAMMING DECISIONS	10 (36%)	6 (19%)	16 (26%)
GENERAL MANAGERIAL DECISIONS	6 (21%)	15 (46%)	21 (35%)

Identification of Decision Styles

This research uses the Jungian typology (Jung, 1970) as operationalized in the Meyers-Briggs Type Indicator (MBTI) to classify decision style. The MBTI measures an individual's preferences in four dichotomous dimensions: Extraversion-Introversion (EI), Sensing-Intuition (SN),

Thinking-Feeling (TF), and Judgment-Perception (JP). Each of these dimensions explains a different part of the decision maker's style.

The EI dimension reflects the individual's orientation to either the outer or inner world. An extravert prefers to be oriented towards the outer world of people and things while an introvert prefers an orientation towards the inner world of concepts and ideas.

The SN dimension reflects the way the individual prefers to perceive information. A sensing individual prefers to gather information directly through one or more of his five senses; this individual perceives facts. In contast, the individual who prefers to gather information indirectly relies on the process of intuition; this individual perceives relationships.

The TF dimension reflects the way the individual prefers to make judgments. Thinking individuals prefer to make judgments objectively and impersonnally. Feeling individuals prefer to make judgments subjectively; they personally weigh values of choices and how they matter to others.

The JP dimension indicates whether an individual prefers to make judgments or make perceptions. Judging individuals, since they would rather make judgments, prefer to live in a decisive and orderly way. While perceiving individuals, since they would rather spend time making

perceptions, prefer a spontaneous and flexible life that allows time for those perceptions.

When all four of these dimensions are combined the result is 16 different preference types. This research uses these preference types to define decision style. Both of the populations are identified in three ways. First, each dimension will be looked at separately. Then, the middle two dimensions will be combined for these two dimensions have the strongest influence on the decision making process. Finally, all of the dimensions will be combined.

<u>Decision Style of Chief of Resources and Requirements</u>. This decision style section reports the findings that resulted from the 64 Meyers-Briggs Type Indicators (MBTI's) that were returned by the Chiefs of Resources and Requirements.

<u>Extraversion-Introversion (EI) Dimension</u>. Of the 64 Chiefs of Resources and Requirements 37 (57.8%) were rated as extraverts and 27 (42.2%) were rated as introverts.

<u>Sensing-Intuition (SN) Dimension</u>. Fifty-three (82.8%) of the Chiefs of Resources and Requirements were rated as sensing types and 11 (17.2%) were rated as intuition types.

<u>Thinking-Feeling (TF) Dimension</u>. Sixty-two (96.9%) of the 64 Chiefs of Resources and Requirements were

TABLE VII

Chiefs' of Resources and Requirements
Individual Decision Style Dimensions

EI DIMENSION	EXTRAVERSION 57.8%	INTROVERSION 42.2%
SN DIMENSION	SENSING 82.8%	INTUITION 17.2%
TF DIMENSION	THINKING 96.9%	FEELING 3.1%
JP DIMENSION	JUDGMENT 85.9%	PERCEPTION 14.1%

rated as thinking types; while, only 2 (3.1%) were rated as feeling types.

Judgment-Perception (JP) Dimension. Fifty-five (85.9%) of the 64 Chiefs of Resources and Requirements were tested as being judgment oriented, and 9 (14.1%) tested as being perception oriented.

Middle Two Dimensions Combined. When the middle two dimensions of perception (SN) and judgment (TF) are combined they define the four core decision styles. These four styles are significant because they describe the way

the individual prefers to perceive and judge information. The four resulting styles are Sensing+Thinking (ST), Sensing+Feeling (SF), Intuition+Thinking (NT), and Intuition+Feeling (NF).

Of the 64 Chiefs of Resources and Requirements who returned their surveys, 52 were rated ST, 1 was rated SF, 10 were rated NT, and 1 was rated NF. The respective percentages of 81.3%, 1.6%, 15.6%, and 1.6% are shown graphically in Figure 9.

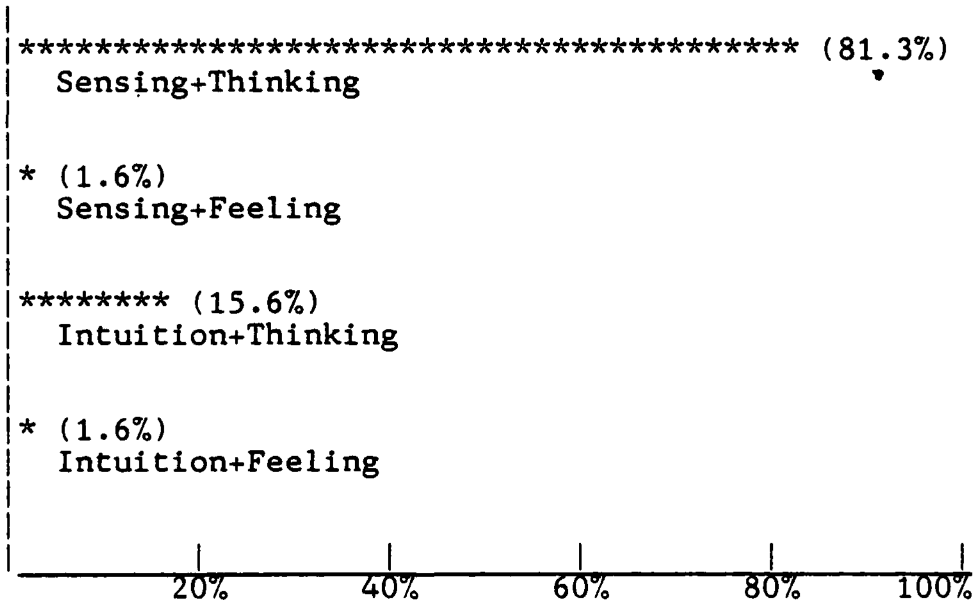

Figure 9. Chiefs' of Resources and Requirements Two Dimension Decision Styles Identified

Four Dimension Decision Style. All four of the dimensions combine to form the 16 different decision styles. The resulting 16 decision styles and the number and percentage of Chiefs of Resources and Requirements polled that demonstrated those styles are shown graphically in Figure 10.

Decision Style of Chief of Operations. This decision style section reports the findings that resulted from the 58 Meyers-Briggs Type Indicators (MBTI's) that were returned by the Chiefs of Operations.

Extraversion-Introversion (EI) Dimension. Of the 58 Chiefs of Operations, 22 (37.9%) were rated as extraverts and 36 (62.1%) were rated as introverts.

Sensing-Intuition (SN) Dimension. Forty-five (77.6%) of the Chiefs of Operations were rated as sensing types and 13 (22.4%) of the Chiefs of Operations were rated as intuition types.

Thinking-Feeling (TF) Dimension. Fifty-five (94.8%) of the 58 Chiefs of Operations were rated as thinking types, while only 3 (5.2%)were rated as feeling types.

Judgment-Perception (JP) Dimension. Forty-seven (81.0%) of the 58 Chiefs of Operations were tested as being judgment oriented. Conversely, 11 (19.0%) of the Chiefs of Operations tested as being perception oriented.

```
|******************** (25 or 39.1%)
|  ESTJ
|
|** (2 or 3.1%)
|  ESTP
|
|* (1 or 1.6%)
|  ESFJ
|
| (0)
|  ESFP
|
|***** (7 or 10.9%)
|  ENTJ
|
|* (1 or 1.6%)
|  ENTP
|
| (0)
|  ENFJ
|
|* (1 or 1.6%)
|  ENFP
|
|**************** (20 or 31.3%)
|  ISTJ
|
|**** (5 or 7.8%)
|  ISTP
|
| (0)
|  ISFJ
|
| (0)
|  ISFP
|
|** (2 or 3.1%)
|  INTJ
|
| (0)
|  INTP
|
| (0)
|  INFJ
|
| (0)
|  INFP
|         |         |         |         |         |
 ---------------------------------------------------
         20%       40%       60%       80%      100%
```

Figure 10. Chiefs' of Resources and Requirements Four Dimension Decision Styles Identified

TABLE VIII

Chiefs' of Operations
Individual Decision Style Dimensions

EI DIMENSION	EXTRAVERSION 37.9%	INTROVERSION 62.1%
SN DIMENSION	SENSING 77.6%	INTUITION 22.4%
TF DIMENSION	THINKING 94.8%	FEELING 5.2%
JP DIMENSION	JUDGMENT 81.0%	PERCEPTION 19.0%

Middle Two Dimensions Combined. When the middle two dimensions of perception (SN) and judgment (TF) are combined they define the four core decision styles. These four styles are significant because they describe the way the individual prefers to perceive and judge information. The four resulting styles are Sensing+Thinking (ST), Sensing+Feeling (SF), Intuition+Thinking (NT), and Intuition+Feeling (NF).

```
|
|************************************* (74.1%)
|  Sensing+Thinking
|
|
|** (3.4%)
|  Sensing+Feeling
|
|
|********** (20.7%)
|  Intuition+Thinking
|
|
|* (1.7%)
|  Intuition+Feeling
|
|
|         |         |         |         |         |
 ------------------------------------------------------
          20%       40%       60%       80%      100%
```

Figure 11. Chiefs' of Operations Two Dimension Decision Styles Identified

Of the 58 Chiefs of Operations who returned their surveys, 43 were rated ST, 2 were rated SF, 12 were rated NT, and 1 was rated NF. The respective percentages of 74.1%, 3.4%, 20.7%, and 1.7% are shown graphically in Figure 11.

Four Dimension Decision Style. All four of the dimensions combine to form the 16 different decision styles. The resulting 16 decision styles and the number and percentage of Chiefs of Operations polled that demonstrated those styles are shown graphically in Figure 12.

|********** (11 or 19.0%)
ESTJ

|** (2 or 3.4%)
ESTP

(0)
ESFJ

(0)
ESFP

|***** (6 or 10.3%)
ENTJ

|*** (3 or 5.2%)
ENTP

(0)
ENFJ

(0)
ENFP

|********************** (26 or 44.8%)
ISTJ

|**** (4 or 6.9%)
ISTP

|* (1 or 1.7%)
ISFJ

|* (1 or 1.7%)
ISFP

|** (2 or 3.4%)
INTJ

|* (1 or 1.7%)
INTP

|* (1 or 1.7%)
INFJ

(0)
INFP

20% 40% 60% 80% 100%

Figure 12. Chiefs' of Operations Four Dimension Decision Styles Identified

Comparison Between Decision Styles of Both Samples

By Each Dimension. The EI dimension presents the largest disparity between the two samples. As seen in Table IX, Chiefs of Resources and Requirements tested at 57.8% extraversion as compared to 37.9% for the Chiefs of Operations. Of course there is a corresponding difference in introversion of 42.2% and 62.1% respectively. A chi-square test for differences between two binomials was used to determine if the two samples are significantly different. The null hypothesis stated the two samples came from the same population. The chi-square test was done for all four dimensions: EI, SN, TF, JP. The null hypothesis was rejected in only the EI dimension. This indicates that these two samples are significantly different along the EI dimension. This test yielded the same results with the alpha (rejection region) varying from .1 to .005 (Meek and Turner, 1983:382).

By Two Dimension Decision Style. The differences in the sample of Chiefs of Resources and Requirements and the sample of Chiefs of Operations were very similiar as they were classified by two dimension decision style. Normally a chi-square test for several multinomials could be used to check for significant difference, unfortunately this could not be done because that test requires that each category contain at least 5%. However, as Table X illustrates, the two samples were within plus or minus 4 of the combined

TABLE IX

Chiefs of Resources and Requirements versus
Chiefs of Operations in each Decision Style Dimension (%)

EI DIMENSION	EXTRAVERSION	INTROVERSION
Ch. of Res & Req'ts	57.8	42.2
Chief of Operations	37.9	62.1
Combined	[48.4]	[51.6]
SN DIMENSION	SENSING	INTUITION
Ch. of Res & Req'ts	82.8	17.2
Chief of Operations	77.6	22.4
Combined	[80.3]	[19.7]
TF DIMENSION	THINKING	FEELING
Ch. of Res & Req'ts	96.9	3.1
Chief of Operations	94.8	5.2
Combined	[95.9]	[4.1]
JP DIMENSION	JUDGMENT	PERCEPTION
Ch. of Res & Req'ts	85.9	14.1
Chief of Operations	81.0	19.0
Combined	[83.6]	[16.4]

sample percentage for each decision style (Meek and Turner, 1983:488-490).

The two samples were within plus or minus 4 of the combined sample percentage for the Sensing+Thinking (ST) decision style. For the Sensing+Feeling (SF) style the difference was less than 1. The difference for the Intuition+Thinking (NT) style was less than 3; while, the difference in the Intuition+Feeling (NF) style was less than 1.

By Four Dimension Decision Style. The comparison by four dimension decision style seems to imply, as did the comparison by two dimension style, that the two samples are very similiar. Out of the 16 different decision styles identified by the four dimensions, only two have a difference greater than 2 from the combined sample percentage. These two styles are ISTJ (difference of 7) and ESTJ (difference of 10). (see Table XI) The only difference in these two styles is in the first dimension of extraversion/introversion (EI). More Chiefs of Operations were ISTJ's; while, more Chiefs of Resources and Requirements were ESTJ's. This is in line with the earlier findings that more Chiefs of Operations were introverted; and more Chiefs of Resources and Requirements were extraverted.

TABLE X

Chiefs of Resources and Requirements versus
Chiefs of Operations by Two Dimension Decision Style

TWO DIMENSION DECISION STYLE	CHIEF OF RES. & REQ	CHIEF OF OPERATIONS	COMBINED
Sensing+Thinking	81.3%	74.1%	77.9%
Sensing+Feeling	1.6%	3.4%	2.5%
Intuition+Thinking	15.6%	20.7%	18.0%
Intuition+Feeling	1.6%	1.7%	1.7%

Predominant Decision Style in Operations Branch

The differences in the extraversion/introversion (EI) dimension just pointed out is the only difference this research found between the two samples. Therefore, except for that dimension the predominance discussed will apply to both samples.

A slight majority of the Chiefs of Operations (62.1% in this sample) are introverts. While, a slight majority of the Chiefs of Resources and Requirements (57.8 in this

TABLE XI

Chiefs of Resources and Requirements versus
Chiefs of Operations by Four Dimension Decision Style

ISTJ Ch. of R & R 31.3% Ch. of Oper. 44.8% Combined 37.7%	**ISFJ** Ch. of R & R 0% Ch. of Oper. 1.7% Combined 0.8%	**INFJ** Ch. of R & R 0% Ch. of Oper. 1.7% Combined 0.8%	**INTJ** Ch. of R & R 3.1% Ch. of Oper. 3.4% Combined 3.3%
ISTP Ch. of R & R 7.8% Ch. of Oper. 6.9% Combined 7.4%	**ISFP** Ch. of R & R 0% Ch. of Oper. 1.7% Combined 0.8%	**INFP** Ch. of R & R 0% Ch. of Oper. 0% Combined 0%	**INTP** Ch. of R & R 0% Ch. of Oper. 1.7% Combined 0.8%
ESTJ Ch. of R & R 39.5% Ch. of Oper. 19.0% Combined 29.5%	**ESFJ** Ch. of R & R 1.6% Ch. of Oper. 0% Combined 0.8%	**ENFJ** Ch. of R & R 0% Ch. of Oper. 0% Combined 0%	**ENTJ** Ch. of R & R 10.9% Ch. of Oper. 10.3% Combined 10.7%
ESTP Ch. of R & R 3.1% Ch. of Oper. 3.4% Combined 3.3%	**ESFP** Ch. of R & R 0% Ch. of Oper. 0% Combined 0%	**ENFP** Ch. of R & R 1.6% Ch. of Oper. 0% Combined 0.8%	**ENTP** Ch. of R & R 1.6% Ch. of Oper. 5.2% Combined 3.3%

sample) are extraverts. When both samples are combined they balance out (51.6% introverts/48.4% extraverts). In summary, the primary managers of the Operations Branch are about half introverts and half extraverts; the Chiefs of Operations tend to be introverts and the Chiefs of Resources and Requirements tend to be extraverted.

A large majority of both of the managers examined in this research are sensing types (80%) versus intuition types, thinking types (96%) versus feeling types, judgment types (84%) versus perception types.

These preferences are reflected in the two dimension decision style also. The managers tend to be primarily sensing-thinking types (78%) and secondarily intuition thinking types (18%) with few either sensing-feeling (2%) or intuition-feeling (2%) types.

Two of the four dimension decision styles stand out as being predominant. They are ISTJ (38%) and ESTJ (30%); together they account for 68% of all the managers. As discussed earlier, a majority (57%) of the ISTJ's are Chiefs of Operations and most (69%) of the ESTJ's are Chiefs of Resources and Requirements. In summary, the predominant decision style among the primary managers within the Operations Branch is -STJ: no predominant first dimension but the other three dimensions have predictable tendencies.

V. Implications and Conclusions

Implications of Decision Types for Decision Support Systems

The decision type best supported by Decision Support Systems is the semistructured decision. Structured decisions are usually supported by data processing systems and unstructured decisions by definition cannot be structured enough to be supported by a DSS.

Semistructured decisions can be analyzed and broken down into their structured and unstructured parts. Then the DSS can aid in the decision process by peforming the structured portions, while the decision maker uses his judgment and intuition to perform the unstructured portions. The process of decision-making is made more effective because the decision maker and the DSS are each performing the decision tasks for which they are best suited.

The majority of the decisions identified in this research were semistructured decisions. Eighty percent of the Chiefs' of Resources and Requirements decisions and seventy-four percent of the Chiefs' of Operations decisions were semistructured. This means because of the types of decisions the two primary managers in the Operations Branch face a DSS could benefit the decision process. This indicates that Air Force Civil Engineering was justified in

planning for a DSS for the Chief of Operations and Chief of Resources and Requirements.

Implications of Decision Style for Decision Support Systems

The predominant two dimension decision style was sensing-thinking (78%). These style individuals prefer to make decisions by focusing their attention on facts and handling these facts with impersonal analysis. They tend to be practical and matter of fact, and their abilities usually lie in their technical skills (Myers, 1980:3). This tendency does not mean that sensing-thinking (ST) style people always handle decisions in this manner. It means that they prefer to make decisions in this manner and they tend to follow their preference (Meyers, 1980:3).

The literature suggests that the ST decision styled individual is likely to feel comfortable using a computer system. One study (Kilmann and Mitroff, 1976:22,25) determined that ST individuals preferred environments characterized by uniformity, certainty, specificity and complete control. Also, ST individuals prefer limited, realistic, economic and down to earth goals. All of these preferences need to be taken into consideration when attempting to support each decision identified by an ST individual.

The two predominant four dimension decision styles are ISTJ (38%) and ESTJ (30%). Naturally they exhibit the same

decision characteristics as sensing-thinkers, since both of these are subsets of the ST decision style. The outer two dimensions give further insight into their preferred approach to decisions.

The introverted ST would prefer to organize the facts and principles in a decision situation. The extraverted ST would rather organize the situation itself by influencing the people involved (Meyers, 1980:6).

The last dimension (JP) indicates whether an individual prefers to make perceptions or judgments. But interpreting this characteristic depends on the first dimension. For extraverts (ESTJ's) the last letter determines their true preference; therefore, an ESTJ will prefer to concentrate on making judgments. Introverts prefer the opposite of what they indicate. Although the introvert's favorite process is the one they prefer to use in the inner world of ideas, they deal with the outer world of people with their auxiliary process, hence introverts indicate their auxiliary process on the MBTI. Thus ISTJ's prefer to concentrate on making perceptions (Meyers, 1980:6).

For Civil Engineering managers, the Chiefs of Operations, because they tended to be ISTJ's, tend to prefer the process of perception. Furthermore, they prefer a sensing type of perception. The Chiefs of Resources and Requirements, since they tended to be ESTJ's, prefer to make

judgments and those judgments are done in a thinking manner.

The ISTJ's, since their preferred process is perception, are more likely to accept another information source like a Decision Support System. However, care must be taken because the managers who are ISTJ's, since their preferred process is perception, tend to spend too much time gathering information. When they are provided a readily accessable computer system there may be a tendency to "play" with the computer system.

In contrast, the ESTJ style manager will tend to need more encouragement to use a computer system in his decision-making process. This is not because they feel uncomfortable about using the computer system, because as ST types they work well when they are using the system. It is a matter of preference. Because the ESTJ's prefer the judging process they tend to spend less time gathering information and more time making decisions. Therefore, ESTJ's prefer using a Decision Support System only as much as they feel it will improve or expedite their decisions. Also, extraverted ESTJ managers will tend to spend more time away from the computer system relating with the people around them.

It is important to remember that the Decision Support System is not just for the 78% who are ST types. The reason for identifying decision style is so that the

decision style of each manager can be considered when supporting the decisions of that manager. The way to make the system for all styles is to make it possible for everyone to tailor the system to meet their decision needs. Ideally, each decision style would have its own model developed to handle each decision in the best way possible for that individual.

For example, ENTJ types handle decisions differently than ESTJ types, since they prefer to gather information through intuition, rather than sensing . These intuitors need to be able to set up the system so that it provides them the possibilities rather than just facts. ESFJ types tend to make decisions differently than both ENTJ and ESTJ types, since they prefer to process information in a feeling, rather than a thinking, manner. These feeling types need to be able to adjust the system so that their feelings can be entered into the decision process.

Example Application

This research has covered many areas relating to decisions and Decision Support Systems; the following example will demonstrate how the ideas brought out in this research can be applied. This scenario will take one decision and follow the procedure used to support that decision.

Identify Decisions. Before a decision can be supported it has to be identified. This research used the

Crawford Slip Method because it is an effective method, especially for large groups. However, any method that can identify decisions can be used. The decision of whether to do work in-house or by contract will be used for the rest of this scenario.

Decision Analysis. Once the decisions are identified they must be analyzed to determine which decisions, or parts of decisions, should be supported by the computer. First the type of decision (structured/ semistructured/ unstructured) must be determined. If the decision is structured, the entire decision can be supported on the computer system. If the decision is unstructured then it cannot be supported by the computer. Semistructured decisions are a hybrid; they have both structured and unstructured parts. The in-house/contract decision is a semistructured decision and must be broken down into its structured and unstructured parts.

The structured part of the decision deals with the facts used in making the decision. Some examples are:

- -The work skills the squadron is short in.
- -The work skills required.
- -Type of work (repair or minor construction).
- -Estimate of man-hours required.
- -Estimated cost.

This information can be kept on the DSS and be referenced when the decision is being made. The unstructured portion

of the decision pertains to the subjective parts of this decision. Some examples are:

-How much to weight the structured variables?

-Is the commander interested in this work?

Identify Decision Style. At this stage the answer to what to model on the DSS has been answered. In order to determine how these decisions are to be modeled the decision style of the person making the decision needs to be known. This scenario is for Civil Engineering's Operations Branch so an ISTJ style is assumed.

Implications of Decision Style. The ISTJ manager's decision support will consist of a model that gives a recommendation that the job be done either in-house or by contract. The model will have a large amount of inputs [since ISTJ's prefer to perceive information]. The variables in the model will be mostly facts [since thinkers prefer impersonal analysis]. The print out, or screen, will show all the data used in the model [since sensors prefer the bare facts].

This model must be adjusted if a manager with a different decision style was making the same decision. If the manager was an ESTJ type instead of an ISTJ type, less inputs would be included in the model. [since ESTJ's prefer to make judgments] Or, if the manager was a feeling type, subjective variables would be added to the model [since feeling types must input their personal values to the decision process]. If the manager was an intuitor, the

print out would show relationships with figures and graphics [since intuitors prefer to gather information through relationships].

Conclusions

It is not possible to give many specifics to incorporate decision style into Decision Support Systems without analyzing each decision that is to be supported. That is not within the scope of this research. However, this research has pointed out that before a Decision Support System can be used effectively the decisions and the decision style of the individuals using the DSS must be identified.

This research has provided a decision-oriented investigation of the two primary managers within Air Force Civil Engineering's Operations Branch. The two managers are the Chief of Operations and the Chief of Resources and Requirements. The decision-oriented investigation focused on two things: 1) Identifying the decisions these two managers face, and 2) Identifying the style in which they make these decisions.

The driving reason for identifying the decisions and decision styles of these two managers was to develop a basis for effectively developing and implementing Civil Engineering's new Decision Support System. This system, called WIMS (Work Information Management System) must

support the decisions in a way that enhances the decision style of the managers using the system. Before this can be accomplished the decisions and decision styles of the managers need to be identified. This research is designed to fill this need.

As pointed out earlier an information system cannot be considered a DSS unless the managers get involved. Therefore, shifting to DSS has changed the role of the manager with respect to the computer system. The manager must transition from a passive receiver of reports, to an active user of an automated system. Without this transition the system cannot support the managers' decisions (Keen and Scott Morton, 1978:13-15).

Now the focus is on the decisions and the decision makers. However, each decision maker is different and these differences can affect the interaction with the DSS. The decision makers are different in style, skill, and knowledge; the DSS should help the decision makers use and develop these differences (Bennett, 1983:19).

The primary step toward involvement that each manager should make is a personal decision analysis. This personal decison analysis should parallel the methodology of this paper on an individual level.

Recommendations For Follow-on Study

This research lends itself to expansion in breadth or depth. This same type research could be accomplished for other branches within Civil Engineering, or any decision makers in any organizational setting. Or, more in depth research could be performed building on this research base. For example, one of the decisions identified in this research could be examined in detail. Different ways to support that decision could be developed for the different decision styles. Also, experimentation and testing of the ways decision style affects decision-making on a Decision Support System would enhance the application of this research.

Appendix A: Chiefs' of Resources and Requirements Decisions

(number of times listed in parentheses)

* Decide best method to accomplish work, either through job order, work order, or contract.(10)
* Decide to approve or disapprove work requests.(9)
* Decide on In-service Work Plan(IWP) schedule.(6)
* Decide how to schedule command interest work.(5)
* Decide on best way to use manpower.(5)
* Decide how to get materials, either base supply or local purchase.(4)
* Decide how to classify work [mission essential or nice to have].(4)
* Decide to approve or disapprove walk through for materials.(3)
* Decide on planning schedule.(3)
* Decide on ratings for subordinates.(2)
* Decide if the squadron has the resources and skills to do the work.(2)
* Decide which work centers need management attention.(2)
* Decide what goes on recurring maintenance plan.(2)
* Decide on work priorities for planning and materials.(2)
* Decide if more information is needed before a decision can be made.(2)
* Decide what jobs Prime BEEF will accomplish.(2)
* Decide on approving and scheduling employee leave.(2)
* Decide best way to use computer terminal time.(2)

(continued)

* Decide on how to estimate work requirements for 5 year maintenance and repair plans.(1)

* Decide how to accomplish command interest work.(1)

* Decide when and how many appliances to order.(1)

* Decide how to reduce planning backlog.(1)

* Decide how to rate efficiency of method of accomplishing work.(1)

* Decide what the long range effects of a decision could be.(1)

* Decide when to authorize overtime.(1)

* Decide proper sequence to handle high priority work.(1)

* Decide which employee to nominate for awards.

* Decide whether to release a work order before it is material complete.(1)

* Decide on prioritizing vehicles for maintenance.(1)

* Decide on which supplies and equipment to buy when money is tight.(1)

* Decide who does work planning [planning section or shops].(1)

* Decide whether to question subordinates' decision or wait to see outcome.(1)

* Decide on vehicle rotation.(1)

* Decide on priority of typing requirements.(1)

* Decide what should be briefed to a higher level.(1)

Appendix B: Chiefs' of Operations Decisions

(number of times listed in parentheses)

* Decide how work will be accomplished [in-house versus by contract].(6)

* Decide how to prioritize work.(5)

* Decide on internal reassignment of personnel.(4)

* Decide to approve or disapprove work request.(4)

* Decide on disciplinary measures.(4)

* Decide on vehicle allocation [size/distribution].(3)

* Decide how to resolve interpersonal conflict at the supervisory level.(3)

* Decide if shops are working at their expected productivity level.(3)

* Decide on a rating for a subordinate. (3)

* Decide what the overhire requirements are.(2)

* Decide how to prioritize command interest items.(2)

* Decide which jobs to "slip" backward in In-service Work Plan [IWP].(2)

* Decide which jobs to concentrate material requisitioning efforts on.(2)

* Decide how to prioritize job vacancies.(2)

* Decide how to schedule work for the In-service Work Plan [IWP].(2)

* Decide to approve or disapprove overtime.(2)

* Decide which Minor Construction (MC) work to defer if we are going over the 5% MC limit on in-house manhours.(2)

* Decide who to recognize with awards.(2)

(continued)

* Decide if issue needs to be sent to a higher level.(1)

* Decide whether to approve or disapprove high cost purchases or equipment rentals.(1)

* Decide what percentage of direct manhours should be held back for contingencies.(1)

* Decide if we should go contract on certain large work orders.(1)

* Decide on the best way to order supplies.(1)

* Decide how to resolve intershop conflicts.(1)

* Decide whether to emphasize quality or quantity.(1)

* Decide which Prime BEEF team to recall.(1)

* Decide which crisis needs immediate attention.(1)

* Decide whether to make a long term repair or a short term fix.(1)

* Decide how to prioritize equipment purchases.(1)

* Decide the best way to reduce the work backlog in specific shops.(1)

* Decide on the best method of tracking work rquests.(1)

* Decide which equipment to shut off when electricity is cut back.(1)

* Decide how to accomplish cathodic protection maintenance without additional personnel.(1)

* Decide if work is being done as planned.(1)

* Decide if work is being accomplished as scheduled.(1)

* Decide if Prime BEEF program is being properly accomplished.(1)

* Decide whether to fix or replace high value items.(1)

* Decide who would be the best person to correct a specific problem.(1)

(continued)

* Decide whether a problem is chronic or an isolated case.(1)

* Decide on a personal daily schedule.(1)

* Decide who to send to meetings.(1)

* Decide on the requirements for base exercises.(1)

* Decide what the training requirements are.(1)

Bibliography

Air Force Engineering and Services Quarterly, 24: 40 (Winter 1983).

Alter, Steven L. Decision Support Systems: Current Practices and Ccntinuing Challenges. Reading MA: Addison-Wesley Publishing Company, Inc. 1980.

Bennett, John L. Building Decisio Support Systems. Reading MA: Addison-Wesley Publishing Company, Inc. 1983.

Bostrom, Robert P. and Kate M. Kaiser. "Personality Characteristics of MIS Project Teams: An Empirical Study and Action Research Design," MIS Quarterly, 6: 43-60 (December 1982).

Byrd, Jack, Jr and L. Ted Moore. Decision Models for Management. New York: McGraw-Hill Book Company, 1982.

Carlyn, Marcia, "An Assessment of the Meyers Briggs Type Indicator," Journal of Personality Assessment, 41: 461-472 (October 1977).

Contrails "The Air Force Cadet Handbook". United States Air Force Academy CO, 1978-79.

Crawford, C. C. and John W. Demidovich. Crawford Slip Method: How to Mobilize Brainpower by Think Tank Technology. Los Angeles: School of Public Administration, University of Southern California. 1983.

Golondzinger, Theodore M. "Doing More With Less," Air Force Engineering and Services Quarterly, 24: 8-11 (Spring 1983).

Hamill, Bill and others. "When You Need It! The Way You Want It!" Air Force Engineering and Services Quarterly, 24: 12-15 (Spring 1983).

Henderson, John C. and Paul C. Nutt. "The Influence of Decision Style on Decision Making Behavior," Management Science, 26: 371-386 (April 1980).

Huysmans, Jan H. B. M.,"The Effectiveness of the Cognitive Style Constraint in Implementing Operations Research Proposals," Management Science, 17: 92-104 (September 1970).

Jung, C. G. Collected Works: Six Psychological Types. Princeton NJ: Princeton University Press, 1970.

Jung, C. G. Psychological Types. London: Keegan Paul, 1923.

Keen, Peter G. W. and James L. McKenney. "How Managers' Minds Work," Harvard Business Review, 52: 79-90 (May-June 1974).

Keen, Peter G. W. and Michael S. Scott Morton. Decision Support Systems: An Organizational Perspective. Reading MA: Addison-Wesley Publishing Company, Inc. 1978.

Kilmann, Ralph H. and Ian I. Mitroff. "Qualitative Versus Quantitative Analysis for Management Science: Different Psychological Types," Interfaces, 6: 17-27 (February 1976).

Lake, P. G. and others. Measuring Human Behavior. New York: Teachers College Press, 1973.

Mason, R. O. and I. I. Mitroff. "A Program for Research on Management Information Systems," Management Science, 19: 475-487 (January 1973).

McCaulley, M. H. and others. "Applications of Psychological Type in Engineering Education," Engineering Education, 73: 394-400 (February 1983).

Meek, Gary E. and Stephen J. Turner. Statistical Analysis for Business Decisions. Boston: Houghton Mifflin Company, 1983.

Meyers, I. B. Introduction to Type. Palo Alto CA: Consulting Psychologists Press, Inc., 1980.

Meyers, I. B. Manual: The Meyers-Briggs Type Indicator. Princeton NJ: Educational Testing Service, 1963.

Robey, Daniel and William Taggart. "Minds and Managers: On the Dual Nature of Human Information Processing and Management," Academy of Management Review, 6: 187-195 (April 1981).

Ruff, Christopher D. Base Engineer Automated Management System: Analysis and Evaluation. Unpublished paper for LM 6.16. Air Force Institute of Technology, Wright-Patterson OH, 1984.

Simon, H. A. The New Science of Management Decision. New York: Harper and Row, 1960.

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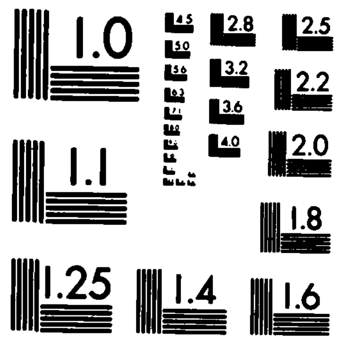

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Stricker, L. J. and J. Ross. "Intercorrelations and Reliability of the Meyers Briggs Type Indicator Scales," Psychological Reports, 12: 287-293 (December 1963).

Sullivan H. P., Jr. "The Innovator: An Interview With Brig. Gen. Jud Ellis," Air Force Engineering and Services Quarterly, 24: 10-16 (Winter 1983).

Szilagyi, Andrew D., Jr. and Marc J. Wallace, Jr. Organizational Behavior and Performance. Glenview IL: Scott, Foresman and Company, 1983.

Vasarhelyi, Miklos A. "Man-Machine Planning Systems: A Cognitive Style Examination of Interactive Decision Making," Journal of Accounting Research, 15: 138-155 (Spring 1977).

Zmud, Robert W. "Individual Differences and MIS Success: A Review of the Empirical Literature," Management Science, 25: 966-979 (October 1979).

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Title: A DECISION-ORIENTED INVESTIGATION OF AIR FORCE CIVIL ENGINEERING'S OPERATIONS BRANCH AND THE IMPLICATIONS FOR A DECISION SUPPORT SYSTEM

Thesis Advisor: Joseph C. Munter, Major, USAF

This investigation identified the decisions and the decision-making styles of the primary managers in Air Force Civil Engineering's Operations Branch. The managers considered were the Chief of Operations and the Chief of Resources and Requirements. Included with this investigation is a discussion of the implications that decisions and decision-making style has for a Decision Support System.

The decisions were identified through the Crawford Slip Method and then categorized by decision type. The decision-making style was defined by the Jungian typology as measured by the Meyers-Briggs Type Indicator. The results determined that the types of decisions in the Operations Branch warrant the support of a Decision Support System. The results also indicated that the managers in the Operations Branch had predictable tendencies towards particular decision-making styles.

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